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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/810,246	03/26/2004	Hiroyuki Shimada	60967 (48229)	1758
21874	7590	07/14/2005	EXAMINER	
EDWARDS & ANGELL, LLP			VU, HUNG K	
P.O. BOX 55874			ART UNIT	
BOSTON, MA 02205			PAPER NUMBER	
			2811	

DATE MAILED: 07/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

SM

<b>Office Action Summary</b>	Application No.	Applicant(s)	
	10/810,246	SHIMADA, HIROYUKI	
	Examiner	Art Unit	
	Hung Vu	2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 27 April 2005.
- 2a) ☒ This action is FINAL.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-6, 20 and 21 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-6, 20 and 21 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 26 March 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                        | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)    | Paper No(s)/Mail Date. _____  |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____   | 6) <input type="checkbox"/> Other: _____                                    |

## DETAILED ACTION

### *Claim Rejections - 35 USC § 102*

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-4 are rejected under 35 U.S.C. 102(a) as being anticipated by Tsujikawa et al.

(PN 6,656,804, of record).

Tsujikawa et al. discloses, as shown in Figures 1A-2 and 7A-7C, a semiconductor device, comprising:

a semiconductor layer (1);

a gate insulator layer (6,3) formed on the semiconductor layer;

a gate electrode (7) formed on the gate insulator layer, wherein the atomic ration of

oxygen atoms included in the gate insulator layer is 5 atm. % or below. Note that Tsujikawa et al. discloses at Col. 4, lines 1-57 that after removal of the silicon oxide film 4, the top surface of the silicon nitride 3 adsorbs oxygen from the atmospheric air, however, the oxygen concentration will decrease to the depth 0.5 nm from the surface. Therefore, it is inherent that below the depth of 0.5 nm, the gate insulator layer will be a pure silicon nitride. As the result, the oxygen concentration will be zero.

Art Unit: 2811

Regarding claim 2, Tsujikawa et al. discloses, as shown in Figures 1A-2 and 7A-7C, a semiconductor device, comprising:

- a semiconductor layer (1);

- a gate insulator layer (6,3) formed on the semiconductor layer and having an interface reaction layer;

- a gate electrode (7) formed on the gate insulator layer, wherein the atomic ration of oxygen atoms included in the gate insulator layer is 5 atm. % or below. Note that Tsujikawa et al. discloses at Col. 4, lines 1-57 that after removal of the silicon oxide film 4, the top surface of the silicon nitride 3 adsorbs oxygen from the atmospheric air to form the interface layer, however, the oxygen concentration will decrease to the depth 0.5 nm from the surface. Therefore, it is inherent that below the depth of 0.5 nm, the gate insulator layer will be a pure silicon nitride. As the result, the oxygen concentration will be zero.

Regarding claim 3, Tsujikawa et al. discloses the gate insulator layer is a silicon nitride layer.

Regarding claim 4, the term “formed by the reaction of a nitrogen species activated by plasma excitation directly with the semiconductor layer” is method recitation in a device claimed.

“[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the

Art Unit: 2811

prior product was made by a different process.” *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985).

2. Claims 20-21 are rejected under 35 U.S.C. 102(e) as being anticipated by En et al. (PN 6,713,819, of record).

Regarding claim 20, En et al. discloses, as shown in Figures 1-3D, a semiconductor device, comprising:

- a semiconductor layer (20);
- a gate insulator layer (38,56) formed on the semiconductor layer;
- a gate electrode (36,54) formed on the gate insulator layer, wherein the atomic ratio of oxygen atoms included in the entire gate insulator layer is 5 atm. % or below. Note that En et al. discloses, at Col. 3, line 66 – Col. 4, line 9, that the gate insulator layer is a silicon nitride. Therefore, the oxygen concentration in the gate insulator layer will be zero.

Regarding claim 21, En et al. discloses, as shown in Figures 1-3D, a semiconductor device, comprising:

- a semiconductor layer (20);
- a gate insulator layer (38,56) formed on the semiconductor layer, wherein the gate insulator layer does not include an interface reaction layer including oxygen at an interface with the gate electrode;
- a gate electrode (36,54) formed on the gate insulator layer, wherein the atomic ratio of oxygen atoms included in the gate insulator layer is 5 atm. % or below. Note that En et al.

Art Unit: 2811

discloses, at Col. 3, line 66 – Col. 4, line 9, that the gate insulator layer is a silicon nitride.

Therefore, the oxygen concentration in the gate insulator layer will be zero.

*Claim Rejections - 35 USC § 103*

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 5 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsujikawa et al. (PN 6,656,804, of record) in view of En (PN 6,713,819, of record).

Regarding claim 5, Tsujikawa et al. discloses the gate electrode includes a silicon. Tsujikawa et al. does not disclose the gate electrode includes a tantalum nitride layer. However, En et al. discloses a gate electrode includes silicon (polysilicon) or a tantalum nitride layer. Note Figure 1 of En et al.. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the gate electrode of Tsujikawa et al. includes a tantalum nitride layer, such as taught by En et al. because silicon and tantalum nitride are commonly used as the gate electrode and they are interchangeable.

Regarding claim 6, the term “formed by sputtering” is method recitation in a device claimed.

“[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the

Art Unit: 2811

same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process.” *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985).

### ***Response to Arguments***

4. Applicant's arguments filed 04/27/05 have been fully considered but they are not persuasive.

It is argued, at page 6 of the Remarks, that Tsujikawa teaches a gate dielectric film 6 comprises multiple layers of silicon oxide film 2 and silicon nitride 3, but does not teach or suggest a gate insulator layer wherein the atomic ratio of oxygen atoms included in the gate insulator layer is 5 atm. % or below. This argument is not convincing because the claimed language does not specifically state whether the gate insulator layer comprising only one layer. Also, Tsujikawa et al. discloses, at Col. 4, lines 1-57 and Col. 6, lines 33-40, that after removal of the silicon oxide film 4, the top surface of the silicon nitride 3 adsorbs oxygen from the atmospheric air to form the interface layer having a thickness of 0.15 nm. The nitrogen concentration is higher than the oxygen concentration in the gate dielectric film's region at depths of 0.15 nm to 0.5 nm from the interface with the gate electrode. Therefore, it is inherent that below the depth of 0.5 nm, the gate insulator layer will be a pure silicon nitride. As the result, the oxygen concentration will be zero.

*Conclusion*

5. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hung K. Vu whose telephone number is (571) 272-1666. The examiner can normally be reached on Mon-Thurs 6:00-3:30, alternate Friday 7:00-3:30, Eastern Time.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on (571) 272-1732. The Central Fax Number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.



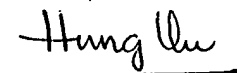
Application/Control Number: 10/810,246

Page 8

Art Unit: 2811

Vu

July 7, 2005

A handwritten signature in cursive script, appearing to read "Hung Vu", is written above a horizontal line.

Hung Vu

Primary Examiner